

**Water Quality Assessment  
Fossil Creek Reservoir  
South Ft. Collins Sanitation District Water Reclamation Facility**

**Table of Contents**

I. WATER QUALITY ASSESSMENT SUMMARY .....	1
II. INTRODUCTION .....	2
III. WATER QUALITY STANDARDS .....	3
<i>Narrative Standards</i> .....	3
<i>Standards for Organic Parameters and Radionuclides</i> .....	4
<i>Salinity</i> .....	5
<i>Temperature</i> .....	5
<i>Segment Specific Numeric Standard</i> .....	5
<i>Table Value Standards and Hardness Calculations</i> .....	6
<i>Total Maximum Daily Loads and Regulation 93 – Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List</i> .....	8
IV. RECEIVING STREAM INFORMATION .....	8
<i>Low Flow Analysis</i> .....	8
<i>Mixing Zones</i> .....	9
<i>Ambient Water Quality</i> .....	9
V. FACILITY INFORMATION AND POLLUTANTS EVALUATED .....	10
<i>Facility Information</i> .....	10
<i>Pollutants of Concern</i> .....	10
VI. DETERMINATION OF WATER QUALITY BASED EFFLUENT LIMITATIONS (WQBELS) .....	11
<i>Technical Information</i> .....	11
<i>Calculation of WQBELS</i> .....	12
<i>Agricultural Use Parameters (SAR and EC):</i> .....	15
VII. ANTIDegradation EVALUATION .....	16
VIII. TECHNOLOGY BASED LIMITATIONS .....	16
<i>Regulations for Effluent Limitations</i> .....	16
IX. REFERENCES .....	17

## **I. Water Quality Assessment Summary**

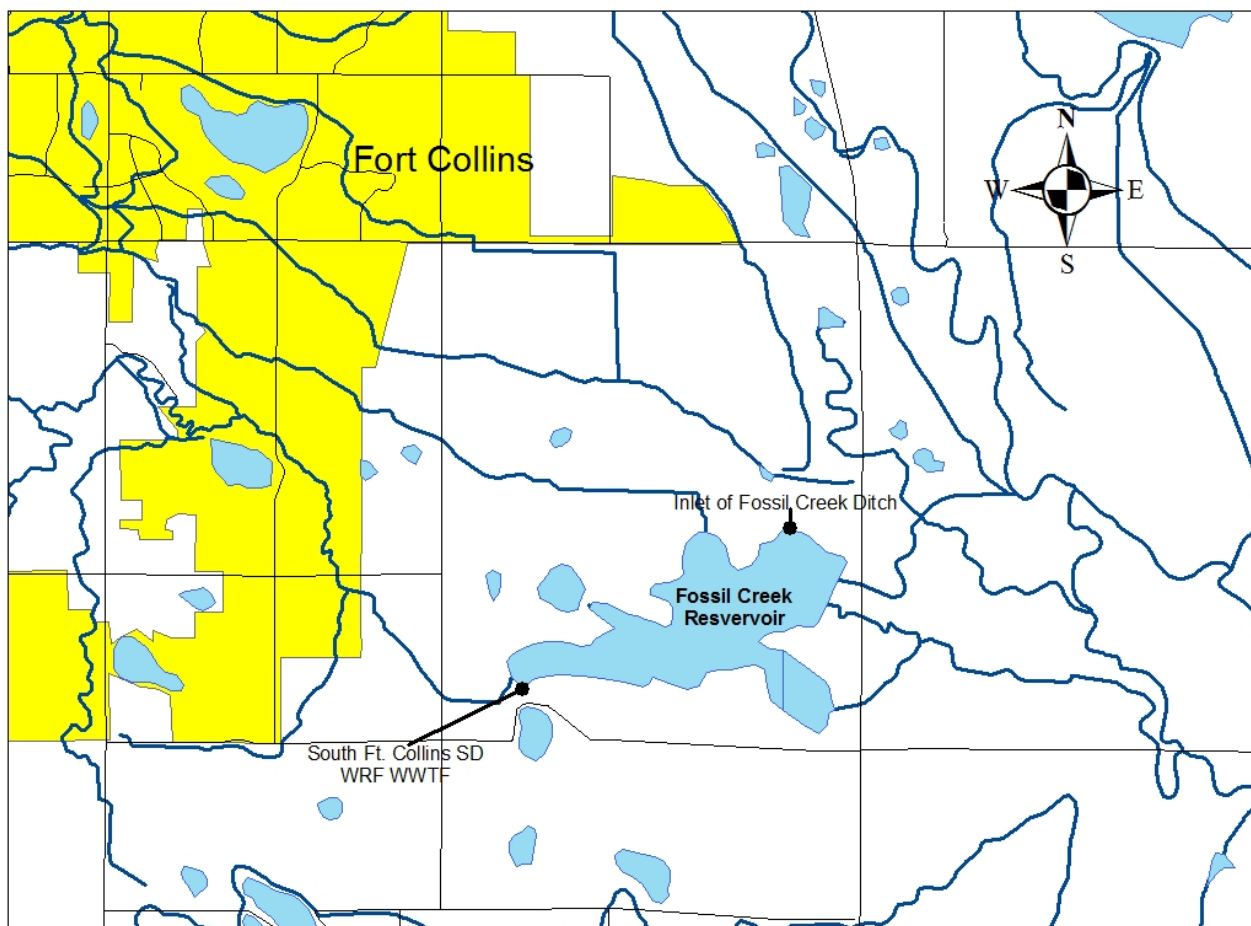
Table A-1 includes summary information related to this WQA. This summary table includes key regulatory starting points used in development of the WQA such as: receiving stream information; threatened and endangered species; 303(d) and Monitoring and Evaluation listings; low flow and facility flow summaries; and a list of parameters evaluated.

Table A-1 WQA Summary					
Facility Information					
Facility Name		Permit Number	Design Flow (max 30-day ave, MGD)	Design Flow (max 30-day ave, CFS)	
South Ft. Collins SD WRF		CO0020737	4.5	7.00	
Receiving Stream Information					
Receiving Stream Name	Segment ID	Designation	Classification(s)		
Fossil Creek Reservoir	COSPCP22	Use Protected	Aquatic Life Warm 2, Recreation Class E, Agriculture		
Low Flows (cfs)					
1E3 (1-day)	7E3 (7-day)	30E3 (30-day)	Ratio of 30E3 to the Design Flow (cfs)		
0	0	0	0:1		
Regulatory Information					
T&E Species	303(d) (Reg 93)	Monitor and Eval (Reg 93)	Existing TMDL	Temporary Modification(s)	Control Regulation
No	None	None	NA	None	None
Pollutants Evaluated					
Ammonia, <i>E. coli</i> , TRC, Metals, Temp, SAR, EC					

## II. Introduction

The water quality assessment (WQA) of Fossil Creek Reservoir near the South Ft. Collins SD WRF waste water treatment facility (South Ft. Collins WWTF), located in Larimer County, is intended to determine the assimilative capacities available for pollutants found to be of concern. This WQA describes how the water quality based effluent limits (WQBELs) are developed. These parameters may or may not appear in the permit with limitations or monitoring requirements, subject to other determinations such as reasonable potential analysis, evaluation of federal effluent limitation guidelines, implementation of state-based technology based limits, mixing zone analyses, 303(d) listings, threatened and endangered species listing, or other requirements as discussed in the permit rationale. Figure A-1 contains a map of the study area evaluated as part of this WQA.

**FIGURE A-1**



The South Ft. Collins WWTF discharges to Fossil Creek Reservoir, which is stream segment COSPCP22. This means the South Platte River Basin, Cache La Poudre River Sub-basin, Stream Segment 22. This segment is composed of the “Fossil Creek Reservoir”. Stream segment COSPCP22 is classified for Aquatic Life Warm 2, Recreation Class E, and Agriculture.

Information used in this assessment includes data gathered from the South Ft. Collins WWTF, Division, River Watch, and the U.S. Environmental Protection Agency (EPA). The data used in the assessment consist of the best information available at the time of preparation of this WQA analysis.

### III. Water Quality Standards

#### Narrative Standards

Narrative Statewide Basic Standards have been developed in Section 31.11(1) of the regulations, and apply to any pollutant of concern, even where there is no numeric standard for that pollutant. Waters of the state shall be free from substances attributable to human-caused point source or nonpoint source discharges in amounts, concentrations or combinations which:

for all surface waters except wetlands;

(i) can settle to form bottom deposits detrimental to the beneficial uses. Depositions are stream bottom buildup of materials which include but are not limited to anaerobic sludge, mine slurry or tailings, silt, or mud; or (ii) form floating debris, scum, or other surface materials sufficient to harm existing beneficial uses; or (iii) produce color, odor, or other conditions in such a degree as to create a nuisance or harm existing beneficial uses or impart any undesirable taste to significant edible aquatic species or to the water; or (iv) are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life; or (v) produce a predominance of undesirable aquatic life; or (vi) cause a film on the surface or produce a deposit on shorelines; and

for surface waters in wetlands;

(i) produce color, odor, changes in pH, or other conditions in such a degree as to create a nuisance or harm water quality dependent functions or impart any undesirable taste to significant edible aquatic species of the wetland; or (ii) are toxic to humans, animals, plants, or aquatic life of the wetland.

In order to protect the Basic Standards in waters of the state, effluent limitations and/or monitoring requirements for any parameter of concern could be put in CDPS discharge permits.

### **Standards for Organic Parameters and Radionuclides**

**Radionuclides:** Statewide Basic Standards have been developed in Section 31.11(2) and (3) of The Basic Standards and Methodologies for Surface Water to protect the waters of the state from radionuclides and organic chemicals.

In no case shall radioactive materials in surface waters be increased by any cause attributable to municipal, industrial, or agricultural practices or discharges to as to exceed the following levels, unless alternative site-specific standards have been adopted. Standards for radionuclides are shown in Table A-2.

<b>Table A-2 Radionuclide Standards</b>	
<b>Parameter</b>	<b>Picocuries per Liter</b>
Americium 241*	0.15
Cesium 134	80
Plutonium 239, and 240*	0.15
Radium 226 and 228*	5
Strontium 90*	8
Thorium 230 and 232*	60
Tritium	20,000

\*Radionuclide samples for these materials should be analyzed using unfiltered (total) samples. These Human Health based standards are 30-day average values for both plutonium and americium.

**Organics:** The organic pollutant standards contained in the Basic Standards for Organic Chemicals Table are applicable to all surface waters of the state for the corresponding use classifications, unless

alternative site-specific standards have been adopted. These standards have been adopted as “interim standards” and will remain in effect until alternative permanent standards are adopted by the Commission. These interim standards shall not be considered final or permanent standards subject to antibacksliding or downgrading restrictions. Although not reproduced in this WQA, the specific standards for organic chemicals can be found in Regulation 31.11(3).

In order to protect the Basic Standards in waters of the state, effluent limitations and/or monitoring requirements for radionuclides, organics, or any other parameter of concern could be put in CDPS discharge permits.

The aquatic life standards for organics apply to all stream segments that are classified for aquatic life. The water supply standards apply only to those segments that are classified for water supply. The water + fish standards apply to those segments that have a Class 1 aquatic life and a water supply classification. The fish ingestion standards apply to Class 1 aquatic life segments that do not have a water supply designation. The water + fish and the fish ingestion standards may also apply to Class 2 aquatic life segments, where the Water Quality Control Commission has made such determination.

Because the Fossil Creek Reservoir is classified for Aquatic Life Warm 2 without a water supply designation, the aquatic life standards apply to this discharge.

### **Salinity**

The Division’s policy, Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops, may be applied to discharges where an agricultural water intake exists downstream of a discharge point. Limitations for electrical conductivity and sodium absorption ratio may be applied in accordance with this policy.

### **Temperature**

Temperature shall maintain a normal pattern of diurnal and seasonal fluctuations with no abrupt changes and shall have no increase in temperature of a magnitude, rate, and duration deemed deleterious to the resident aquatic life. This standard shall not be interpreted or applied in a manner inconsistent with section 25-8-104, C.R.S.

### **Segment Specific Numeric Standards**

Numeric standards are developed on a basin-specific basis and are adopted for particular stream segments by the Water Quality Control Commission. The standards in Table A-3 have been assigned to stream segment COSPCP22 in accordance with the *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin*.

<b>Table A-3</b>	
<b>In-stream Standards for Stream Segment COSPCP22</b>	
<i>Physical and Biological</i>	
Dissolved Oxygen (DO) = 5 mg/l, minimum	

pH = 6.5 - 9 su
E. coli chronic = 126 colonies/100 ml
Temperature April-Dec = 26.3° C MWAT and 29.5° C DM
Temperature Jan-March = 13.2° C MWAT and 14.8° C DM
<b><i>Inorganic</i></b>
Total Ammonia acute and chronic = TVS
Chlorine acute = 0.019 mg/l
Chlorine chronic = 0.011 mg/l
Free Cyanide acute = 0.005 mg/l
Sulfide chronic = 0.002 mg/l
Boron chronic = 0.75 mg/l
Nitrite acute = 0.5 mg/l
Nitrate acute = 100 mg/l
<b><i>Metals</i></b>
Dissolved Arsenic acute = 340 µg/l
Total Recoverable Arsenic chronic = 100 µg/l
Dissolved Cadmium acute and chronic = TVS
Dissolved Trivalent Chromium acute and chronic = TVS
Dissolved Hexavalent Chromium acute and chronic = TVS
Dissolved Copper acute and chronic = TVS
Total Recoverable Iron chronic = 1,000 µg/l
Dissolved Lead acute and chronic = TVS
Dissolved Manganese acute and chronic = TVS
Total Mercury chronic = 0.01 µg/l
Dissolved Nickel acute and chronic = TVS
Dissolved Selenium acute and chronic = TVS
Dissolved Silver acute and chronic = TVS
Dissolved Zinc acute and chronic = TVS
Nonylphenol acute = 28 µg/l
Nonylphenol chronic = 6.6 µg/l

### **Table Value Standards and Hardness Calculations**

Standards for metals are generally shown in the regulations as Table Value Standards (TVS), and these often must be derived from equations that depend on the receiving stream hardness or species of fish present; for ammonia, standards are discussed further in Section IV of this WQA. The Classification and Numeric Standards documents for each basin include a specification for appropriate hardness values to be used. Specifically, the regulations state that:

The hardness values used in calculating the appropriate metal standard should be based on the lower 95% confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic

low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not appropriate, a site-specific method should be used.

Hardness data for Fossil Creek Reservoir near the point of discharge of the South Ft. Collins WWTF were insufficient to conduct a regression analysis based on the low flow. The hardness of lakes does not vary like that of streams and it is not necessary to calculate a hardness regression for Fossil Creek reservoir.

The mean hardness was computed to be 381 mg/l based on sampling data from WQCD Station 5373 on Fossil Creek at Hwy. 287, and River Watch Stations 601 and 513 on Spring Creek. These locations were used as comparable streams in the absence of recent available data for Fossil Creek Reservoir. This hardness value and the formulas contained in the TVS were used to calculate the in-stream water quality standards for metals, with the results shown in Table A-4.

<b>Table A-4</b> <b>TVS-Based Metals Water Quality Standards for CO0020737</b> Based on the Table Value Standards Contained in the Colorado Department of Public Health and Environment Water Quality Control Commission <i>Regulation 38</i>			
<i>Parameter</i>	<i>In-Stream Water Quality Standard</i>		<i>TVS Formula:</i> <i>Hardness (mg/l) as CaCO<sub>3</sub> = 381 mg/l</i>
Cadmium, Dissolved	Acute	8.8 µg/l	$[1.136672-0.041838\ln(\text{hardness})]e^{(0.9151(\ln(\text{hardness}))-3.1485)}$
	Chronic	1.2 µg/l	$[1.101672-0.041838\ln(\text{hardness})]e^{(0.7998(\ln(\text{hardness}))-4.4451)}$
Chromium III, Dissolved	Acute	1704 µg/l	$e^{(0.819(\ln(\text{hardness}))+2.5736)}$
	Chronic	222 µg/l	$e^{(0.819(\ln(\text{hardness}))+0.5340)}$
Chromium VI, Dissolved	Acute	16 µg/l	Numeric standards provided, formula not applicable
	Chronic	11 µg/l	Numeric standards provided, formula not applicable
Copper, Dissolved	Acute	47 µg/l	$e^{(0.9422(\ln(\text{hardness}))-1.7408)}$
	Chronic	28 µg/l	$e^{(0.8545(\ln(\text{hardness}))-1.7428)}$
Lead, Dissolved	Acute	267 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-1.46)}]$
	Chronic	10 µg/l	$[1.46203-0.145712\ln(\text{hardness})][e^{(1.273(\ln(\text{hardness}))-4.705)}]$
Manganese, Dissolved	Acute	4,662 µg/l	$e^{(0.3331(\ln(\text{hardness}))+6.4676)}$
	Chronic	2,576 µg/l	$e^{(0.3331(\ln(\text{hardness}))+5.8743)}$
Nickel, Dissolved	Acute	1,452 µg/l	$e^{(0.846(\ln(\text{hardness}))+2.253)}$
	Chronic	161 µg/l	$e^{(0.846(\ln(\text{hardness}))+0.0554)}$
Selenium, Dissolved	Acute	18.4 µg/l	Numeric standards provided, formula not applicable
	Chronic	4.6 µg/l	Numeric standards provided, formula not applicable
Silver, Dissolved	Acute	20 µg/l	$\frac{1}{2} e^{(1.72(\ln(\text{hardness}))-6.52)}$

	Chronic	3.2 $\mu\text{g/l}$	$e^{(1.72(\ln(\text{hardness}))-9.06)}$
Zinc, Dissolved	Acute	448 $\mu\text{g/l}$	$0.978e^{(0.8525(\ln(\text{hardness}))+1.0617)}$
	Chronic	389 $\mu\text{g/l}$	$0.986e^{(0.8525(\ln(\text{hardness}))+0.9109)}$

### **Total Maximum Daily Loads and Regulation 93 – Colorado’s Section 303(d) List of Impaired Waters and Monitoring and Evaluation List**

This stream segment is not listed on the Division’s 303(d) list of water quality impacted streams and is not on the monitoring and evaluation list.

## **IV. Receiving Stream Information**

### **Low Flow Analysis**

The Colorado Regulations specify the use of low flow conditions when establishing water quality based effluent limitations, specifically the acute and chronic low flows. The acute low flow, referred to as 1E3, represents the one-day low flow recurring in a three-year interval, and is used in developing limitations based on an acute standard. The 7-day average low flow, 7E3, represents the seven-day average low flow recurring in a 3 year interval, and is used in developing limitations based on a Maximum Weekly Average Temperature standard (MWAT). The chronic low flow, 30E3, represents the 30-day average low flow recurring in a three-year interval, and is used in developing limitations based on a chronic standard.

Although there is water in Fossil Creek Reservoir at the South Ft. Collins WWTF, the 1E3, 7E3, and 30E3 annual and monthly low flows are set at zero based on the fact this is a reservoir discharge and no mixing zone study has been presented to the Division to indicate more dilution is occurring. For this analysis, low flows are summarized in Table A-5.

<b>Table A-5</b>													
<b>Low Flows for Fossil Creek Reservoir at the South Ft. Collins SD WWTF</b>													
<i>Low Flow (cfs)</i>	<i>Annual</i>	<i>Jan</i>	<i>Feb</i>	<i>Mar</i>	<i>Apr</i>	<i>May</i>	<i>Jun</i>	<i>Jul</i>	<i>Aug</i>	<i>Sep</i>	<i>Oct</i>	<i>Nov</i>	<i>Dec</i>
1E3 Acute	0	0	0	0	0	0	0	0	0	0	0	0	0
7E3 Chronic	0	0	0	0	0	0	0	0	0	0	0	0	0
30E3 Chronic	0	0	0	0	0	0	0	0	0	0	0	0	0



The ratio of the low flow of Fossil Creek Reservoir to the South Ft. Collins WWTF design flow is 0:1

Note that since the low flow has been determined to be zero, the ambient water quality discussion is unnecessary and has therefore been deleted in this WQA. This is explained in more detail under the Technical Information discussion in Section VI.

### **Mixing Zones**

The amount of the available assimilative capacity (dilution) that may be used by the permittee for the purposes of calculating the WQBELs may be limited in a permitting action based upon a mixing zone analysis or other factor. These other factors that may reduce the amount of assimilative capacity available in a permit are: presence of other dischargers in the vicinity; the presence of a water diversion downstream of the discharge (in the mixing zone); the need to provide a zone of passage for aquatic life; the likelihood of bioaccumulation of toxins in fish or wildlife; habitat considerations such as fish spawning or nursery areas; the presence of threatened and endangered species; potential for human exposure through drinking water or recreation; the possibility that aquatic life will be attracted to the effluent plume; the potential for adverse effects on groundwater; and the toxicity or persistence of the substance discharged.

Unless a facility has performed a mixing zone study during the course of the previous permit, and a decision has been made regarding the amount of the assimilative capacity that can be used by the facility, the Division assumes that the full assimilative capacity can be allocated. Note that the review of mixing study considerations, exemptions and perhaps performing a new mixing study (due to changes in low flow, change in facility design flow, channel geomorphology or other reason) is evaluated in every permit and permit renewal.

If a mixing zone study has been performed and a decision regarding the amount of available assimilative capacity has been made, the Division may calculate the water quality based effluent limitations (WQBELs) based on this available capacity. In addition, the amount of assimilative capacity may be reduced by T&E implications.

Since the receiving stream has a zero low flow as calculated above, the WQBELs would be equal to the WQS, and therefore consideration of full or reduced assimilative capacity is inconsequential.

Because of the recreation uses of Fossil Creek Reservoir, there is a high possibility of ingestion of small quantities of lake water, so there will be no mixing zone for *E. coli* allowed and the *E. coli* limit will be set to the water quality standard.

### **Ambient Water Quality**

The Division evaluates ambient water quality based on a variety of statistical methods as prescribed in Section 31.8(2)(a)(i) and 31.8(2)(b)(i)(B) of the *Colorado Department of Public Health and Environment Water Quality Control Commission Regulation No. 31*, and as outlined in the Division's Policy for Characterizing Ambient Water Quality for Use in Determining Water Quality Standards Based Effluent Limits (WQP-19). Other than for hardness to calculate TVS metals

values, the ambient water quality was not assessed for Fossil Creek Reservoir because the background in-stream low flow condition is zero.

## **V. Facility Information and Pollutants Evaluated**

### **Facility Information**

The South Ft. Collins SD Water Reclamation Facility WWTF is located at in the SW 1/4 of S17, T6N, R68W; 2560 East County Road 23 in Ft. Collins, CO; at 40.48469° latitude North and 105.02794° longitude West in Larimer County. The current design capacity of the facility is 4.5 MGD (7.00 cfs). Wastewater treatment is accomplished using a mechanical wastewater treatment process. The technical analyses that follow include assessments of the assimilative capacity based on this design capacity.

An assessment of Division records indicate that there is one facility discharging to the same stream segment. The City of Fort Collins Drake WWTF (CO0047627) also discharges to Fossil Creek Reservoir via the Fossil Creek Ditch which enters the reservoir in the northeast section of the reservoir (see Fig. A-1). The South Ft. Collins WWTF and Drake WWTF discharges are over two miles from each other on opposite sides (lengthwise) of the reservoir.

Due to the distance traveled and location of the discharges to the reservoir modeling the Drake WWTF in conjunction with the South Ft. Collins WWTF was not necessary at this time.

### **Pollutants of Concern**

Pollutants of concern may be determined by one or more of the following: facility type; effluent characteristics and chemistry; effluent water quality data; receiving water quality; presence of federal effluent limitation guidelines; or other information. Parameters evaluated in this WQA may or may not appear in a permit with limitations or monitoring requirements, subject to other determinations such as a reasonable potential analysis, mixing zone analyses, 303(d) listings, threatened and endangered species listings or other requirement as discussed in a permit rationale.

There are no site-specific in-stream water quality standards for BOD<sub>5</sub> or CBOD<sub>5</sub>, TSS, percent removal, and oil and grease for this receiving stream. Thus, assimilative capacities were not determined for these parameters. The applicable limitations for these pollutants can be found in Regulation No. 62 and will be applied in the permit for the WWTF.

The following parameters were identified by the Division as pollutants to be evaluated for this facility:

- Total Residual Chlorine
- *E. coli*
- Ammonia
- Temperature
- SAR and EC
- Metals and Cyanide

It is the Division's standard procedure to consider metals and cyanide as potential pollutants of concern for all major domestic WWTFs.

During assessment of the facility, nearby facilities, and receiving stream water quality, no additional parameters were identified as pollutants of concern.

## VI. Determination of Water Quality Based Effluent Limitations (WQBELs)

### Technical Information

Note that the WQBELs developed in the following paragraphs, are calculations of what an effluent limitation may be in a permit. The WQBELs for any given parameter, will be compared to other potential limitations (federal Effluent Limitations Guidelines, State Effluent Limitations, or other applicable limitation) and typically the more stringent limit is incorporated into a permit. If the WQBEL is the more stringent limitation, incorporation into a permit is dependent upon a reasonable potential analysis.

In-stream background data and low flows evaluated in Sections II and III are used to determine the assimilative capacity of Fossil Creek Reservoir near the South Ft. Collins WWTF for pollutants of concern, and to calculate the WQBELs. For all parameters except ammonia, it is the Division's approach to calculate the WQBELs using the lowest of the monthly low flows (referred to as the annual low flow) as determined in the low flow analysis. For ammonia, it is the standard procedure of the Division to determine monthly WQBELs using the monthly low flows, as the regulations allow the use of seasonal flows.

The Division's standard analysis consists of steady-state, mass-balance calculations for most pollutants and modeling for pollutants such as ammonia. The mass-balance equation is used by the Division to calculate the WQBELs, and accounts for the upstream concentration of a pollutant at the existing quality, critical low flow (minimal dilution), effluent flow and the water quality standard. The mass-balance equation is expressed as:

$$M_2 = \frac{M_3 Q_3 - M_1 Q_1}{Q_2}$$

Where,

$Q_1$  = Upstream low flow (1E3 or 30E3)

$Q_2$  = Average daily effluent flow (design capacity)

$Q_3$  = Downstream flow ( $Q_1 + Q_2$ )

$M_1$  = In-stream background pollutant concentrations at the existing quality

$M_2$  = Calculated WQBEL

$M_3$  = Water Quality Standard, or other maximum allowable pollutant concentration

When  $Q_1$  equals zero,  $Q_2$  equals  $Q_3$ , and the following results:

$$M_2 = M_3$$

Because the low flow ( $Q_l$ ) for Fossil Creek Reservoir is zero, the WQBELs for Fossil Creek Reservoir for the pollutants of concern are equal to the in-stream water quality standards.

A more detailed discussion of the technical analysis is provided in the pages that follow.

### **Calculation of WQBELs**

Using the mass-balance equation provided in the beginning of Section VI, the acute and chronic low flows set out in Section IV, ambient water quality as discussed in Section IV, and the in-stream standards shown in Section III, the WQBELs for were calculated. The data used and the resulting WQBELs,  $M_2$ , are set forth in Table A-7a for the chronic WQBELs and A-7b for the acute WQBELs.

When the ambient water quality exceeds the in-stream standard, the Division standard procedure is to allocate the water quality standard to prevent further degradation of the receiving waters.

Note that although there is very limited ambient water quality for Fossil Creek Reservoir at this time, there is also no dilution applied either which negates the need for ambient data at this time. This will be the case until a mixing zone study on the discharge to the reservoir has not been presented to the Division for the South Ft. Collins WWTF.

**Chlorine:** There are no point sources discharging total residual chlorine within one mile of the South Ft. Collins WWTF. Because chlorine is rapidly oxidized, in-stream levels of residual chlorine are detected only for a short distance below a source. Ambient chlorine was therefore assumed to be zero.

The WQBEL calculations are shown in Table A-7a and A-7b.

***E. coli*:** Note that because of the existing recreation uses of Fossil Creek Reservoir the *E. coli* limitations will be set to the stream standard applicable for the reservoir waters. For *E. coli*, the Division establishes the 7-day geometric mean limit as two times the 30-day geometric mean limit and also includes maximum limits of 2,000 colonies per 100 ml (30-day geometric mean) and 4,000 colonies per 100 ml (7-day geometric mean). This 2000 colony limitation also applies to discharges to ditches.

**Temperature:** A WQBEL for temperature can only be calculated if there is representative data, in the proper form, to determine what the background Maximum Weekly Average Temperature and Daily Maximum ambient temperatures are. As this data is not available at this time, the temperature limitation will be set at the water quality standard and will be revisited in the future when representative temperature data becomes available.

### **Metals and Cyanide**

Metals and cyanide may be present at large domestic WWTFs that accept discharges from industrial contributors. It is the standard approach of the WQCD to determine the available assimilative capacities for cyanide and those metals for which ambient water quality standards are available.

Using the mass-balance equations provided in the beginning of Section IV, the low flows provided in Section III, the background concentrations contained in Section II, and the in-stream standards for

metals shown in Section II, assimilative capacities were calculated. The data used and the resulting calculations of the allowable discharge concentrations,  $M_2$ , are set forth as follows in Table A-6a and A-6b.

<b>Table A-6a</b>						
<b>Chronic WQBELs</b>						
<i>Parameter</i>	$Q_1$ (cfs)	$Q_2$ (cfs)	$Q_3$ (cfs)	$M_1$	$M_3$	$M_2$
Temp MWAT (°C) April-Dec	0	7	7	NA	26	<b>26.3</b>
Temp MWAT (°C) Jan-March	0	7	7	NA	13	<b>13.2</b>
<i>E. coli</i> (#/100 ml)	0	7	7	1	126	<b>126</b>
TRC (mg/l)	0	7	7	0	0.011	<b>0.011</b>
As, TR (µg/l)	0	7	7	0	100	<b>100</b>
Cd, Dis (µg/l)	0	7	7	0	1.2	<b>1.2</b>
Cr+3, Dis (µg/l)	0	7	7	0	222	<b>222</b>
Cr+6, Dis (µg/l)	0	7	7	0	11	<b>11</b>
Cu, Dis (µg/l)	0	7	7	0	28	<b>28</b>
Fe, TR (µg/l)	0	7	7	0	1,000	<b>1,000</b>
Pb, Dis (µg/l)	0	7	7	0	10	<b>10</b>
Mn, Dis (µg/l)	0	7	7	0	2,576	<b>2,576</b>
Hg, Tot (µg/l)	0	7	7	0	0.01	<b>0.01</b>
Ni, Dis (µg/l)	0	7	7	0	161	<b>161</b>
Se, Dis (µg/l)	0	7	7	0	4.6	<b>4.6</b>
Ag, Dis (µg/l)	0	7	7	0	3.2	<b>3.2</b>
Zn, Dis (µg/l)	0	7	7	0	389	<b>389</b>
Nonylphenol (µg/l)	0	7	7	0	6.6	<b>6.6</b>

<b>Table A-6b</b>						
<b>Acute WQBELs</b>						
<i>Parameter</i>	$Q_1$ (cfs)	$Q_2$ (cfs)	$Q_3$ (cfs)	$M_1$	$M_3$	$M_2$
Temp Daily Max (°C) April-Dec	0	7	7	NA	29.5	<b>29.5</b>
Temp Daily Max (°C) Jan-March	0	7	7	NA	14.8	<b>14.8</b>
<i>E. coli</i> (#/100 ml)	See WQBELs ch, line 121 for E Coli calculations: chronic X 2 = acute					<b>252</b>
TRC (mg/l)	0	7	7	0	0.019	<b>0.019</b>
As, Dis (µg/l)	0	7	7	0	340	<b>340</b>
Cd, Dis (µg/l)	0	7	7	0	8.8	<b>8.8</b>
Cr+3, Dis (µg/l)	0	7	7	0	1,704	<b>1,704</b>
Cr+6, Dis (µg/l)	0	7	7	0	16	<b>16</b>
Cu, Dis (µg/l)	0	7	7	0	47	<b>47</b>
CN, Free (µg/l)	0	7	7	0	5	<b>5</b>
Pb, Dis (µg/l)	0	7	7	0	267	<b>267</b>
Mn, Dis (µg/l)	0	7	7	0	4,662	<b>4,662</b>
Hg, Tot (µg/l)	0	7	7	0	NA	<b>NA</b>
Ni, Dis (µg/l)	0	7	7	0	1,452	<b>1,452</b>
Se, Dis (µg/l)	0	7	7	0	18.4	<b>18</b>

Ag, Dis (µg/l)	0	7	7	0	20	<b>20</b>
Zn, Dis (µg/l)	0	7	7	0	448	<b>448</b>

**Ammonia:** The Ammonia Toxicity Model (AMMTOX) is a software program designed to project the downstream effects of ammonia and the ammonia assimilative capacities available to each discharger based on upstream water quality and effluent discharges. To develop data for the AMMTOX model, an in-stream water quality study should be conducted of the upstream receiving water conditions, particularly the pH and corresponding temperature, over a period of at least one year.

Limited pH data sets reflecting receiving water conditions were available for Fossil Creek Reservoir based on some data from Fossil and Spring Creek's. Recent effluent pH data were available from the South Ft. Collins DMRs and were used to establish the average facility contributions in the AMMTOX model. The new pH data led to slightly different total ammonia effluent limits than were previously done for PELs for the WWTF. While these latest total ammonia effluent limits are slightly more stringent than previous levels, current effluent data from the WWTF shows the facility can still meet these more stringent limits.

There were no temperature data available for Fossil Creek Reservoir or the South Ft. Collins WWTF that could be used as adequate input data for the AMMTOX model. Therefore, the Division standard procedure is to rely on statistically-based, regionalized data for pH and temperature compiled from similar facilities and receiving waters.

The AMMTOX may be calibrated for a number of variables in addition to the data discussed above. The values used for the other variables in the model are listed below:

- Stream velocity =  $0.3Q^{0.4d}$
- Default ammonia loss rate = 6/day
- pH amplitude was assumed to be medium
- Default times for pH maximum, temperature maximum, and time of day of occurrence
- pH rebound was set at the default value of 0.2 su per mile
- Temperature rebound was set at the default value of 0.7 degrees C per mile.

The results of the ammonia analyses for the South Ft. Collins WWTF are presented in Table A-7.

<b>Table A-7</b> <b>AMMTOX Results for Fossil Creek Reservoir</b> <b>at the South Ft. Collins WWTF</b>		
<b>Month</b>	<b>Chronic (mg/l)</b>	<b>Acute (mg/l)</b>
<b>January</b>	5.8	34
<b>February</b>	6.1	35
<b>March</b>	5.4	32
<b>April</b>	5.0	32
<b>May</b>	4.3	30
<b>June</b>	3.5	28

<b>July</b>	3.1	28
<b>August</b>	2.8	25
<b>September</b>	3.1	25
<b>October</b>	3.6	27
<b>November</b>	4.7	31
<b>December</b>	5.4	31

### **Agricultural Use Parameters (SAR and EC):**

Section 31.11(1)(a)(iv) of *The Basic Standards and Methodologies for Surface Waters* (Regulation No. 31) includes the narrative standard that State surface waters shall be free of substances that are harmful to the beneficial uses or toxic to humans, animals, plants, or aquatic life. The interpretation of these conditions (i.e., “no harm to plants” and “no harm to the beneficial uses”) and how they were to be applied in permits were contemplated by the Division as part of an Agricultural Work Group, and culminated in the most recent policy entitled *Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops* (hereafter the Narrative Standards policy)

Based on available information, the water in **Fossil Creek Reservoir** is used for irrigation water. The evaluation of the suitability (i.e., quality) of irrigation water is complex and involves the detailed understanding of the interactions of plant tolerances, soil types, and agricultural management practices. Irrigation water has two properties – salinity and sodicity – that can have concurrent impacts on the irrigated crop beneficial use. The Division has thus determined that two parameters, specifically electrical conductivity (EC) and sodium absorption ratio (SAR), are the best parameters to regulate in discharge permits to control levels of salts to minimize both the loss of irrigated crop yield and the sodium hazard.

In order to establish “standards” and limits for EC and SAR, the Division must: (1) determine the most sensitive crop usually grown in the area downstream from the discharge and determine the corresponding EC of irrigation water ( $EC_w$ ) threshold value for no reduction in yield below 100%; and (2) determine the SAR based on the  $EC_w$  value, with consideration of existing water quality, to prevent the exceedance of the SAR.

**Electrical Conductivity:** The electrical conductivity (EC) is also known as specific conductance, conductance, conductivity, or specific conductivity. Crops have varying sensitivity to electrical conductivity. Studies have established the maximum conductivity in the water in the root zone that will result in no reduction of crop yield. This value is referred to as the EC saturation extract or  $EC_e$ . However, the  $EC_e$  is not the same as the EC of the irrigation water ( $EC_w$ ). The  $EC_w$  is the maximum conductivity in the irrigation water that will result in no reduction in crop yield.

This discharge is from a domestic WWTF that receives only typical domestic sewage influent and the TDS of the effluent is less than 800 mg/l. Therefore in accordance with the Division’s Narrative Standard Policy WQP-24, no SAR or ECs limitations are required.

## VII. Antidegradation Evaluation

As set out in *The Basic Standards and Methodologies for Surface Water*, Section 31.8(2)(b), an antidegradation analysis is required except in cases where the receiving water is designated as “Use Protected.” Note that “Use Protected” waters are waters “that the Commission has determined do not warrant the special protection provided by the outstanding waters designation or the antidegradation review process” as set out in Section 31.8(2)(b). The antidegradation section of the regulation became effective in December 2000, and therefore antidegradation considerations are applicable to this WQA analysis.

According to the *Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin*, stream segment COSPCP22 is Use Protected. Because the receiving waters are designated as Use Protected, no antidegradation review is necessary in accordance with the regulations. Thus, for purposes of this WQA analysis, antidegradation review requirements have been met and no further antidegradation evaluation is necessary. Thus, an antidegradation review is required for this segment if new or increased impacts are found to occur.

## VIII. Technology Based Limitations

### Regulations for Effluent Limitations

Regulation No. 62, the Regulations for Effluent Limitations, includes effluent limitations that apply to all discharges of wastewater to State waters, with the exception of storm water and agricultural return flows. These regulations are applicable to the discharge from the proposed discharge.

According to Part 62.4(2) of the Regulations for Effluent Limitations "If the Commission has not so promulgated effluent limitation guidelines for any particular industry, but that industry is subject to effluent limitation guidelines promulgated by the United States Environmental Protection Agency pursuant to the Federal Water Pollution Control Act of 1972, the effluent from these industries shall be subject to the applicable EPA guidelines and shall not be subject to the effluent limitations of Regulation 62.4." Therefore, the limitation for oil and grease in Regulation 62.5 (10 mg/l) shall not apply to this discharge.

Table A-8 contains a summary of the applicable limitations for pollutants of concern at this facility.

<b>Table A-8</b>			
<b>Regulation 62 Based Limitations</b>			
<b>Parameter</b>	<b>30-Day Average</b>	<b>7-Day Average</b>	<b>Instantaneous Maximum</b>
BOD <sub>5</sub>	30 mg/l	45 mg/l	NA
BOD <sub>5</sub> Percent Removal	85%	NA	NA
TSS, mechanical plant	30 mg/l	45 mg/l	NA
TSS, aerated lagoon	75 mg/l	110 mg/l	NA
TSS, non-aerated lagoon	105 mg/l	160 mg/l	NA
TSS Percent Removal	85%	NA	NA
Total Residual Chlorine	NA	NA	0.5 mg/l
pH	NA	NA	6.0-9.0 s.u.
Oil and Grease	NA	NA	10 mg/l



## IX. References

### Regulations:

*The Basic Standards and Methodologies for Surface Water, Regulation 31*, Colorado Department Public Health and Environment, Water Quality Control Commission, effective September 30, 2012.

*Classifications and Numeric Standards for South Platte River Basin, Laramie River Basin, Republican River Basin, Smoky Hill River Basin, Regulation No. 38*, Colorado Department Public Health and Environment, Water Quality Control Commission, effective 1/1/2012

*Regulations for Effluent Limitations, Regulation 62*, CDPHE, WQCC, March 30, 2008.

*Colorado's Section 303(d) List of Impaired Waters and Monitoring and Evaluation List, Regulation 93*, Colorado Department Public Health and Environment, Water Quality Control Commission, effective April 30, 2012.

### Policy and Guidance Documents:

*Antidegradation Significance Determination for New or Increased Water Quality Impacts, Procedural Guidance*, Colorado Department Public Health and Environment, Water Quality Control Division, December 2001.

*Memorandum Re: First Update to (Antidegradation) Guidance Version 1.0*, Colorado Department Public Health and Environment, Water Quality Control Division, April 23, 2002.

*Rationale for Classifications, Standards and Designations of Segments of the South Platte River*, Colorado Department Public Health and Environment, Water Quality Control Division, effective October 29, 2002.

*Policy Concerning Escherichia coli versus Fecal Coliform*, CDPHE, WQCD, July 20, 2005.

*Colorado Mixing Zone Implementation Guidance*, Colorado Department Public Health and Environment, Water Quality Control Division, effective April 2002.

*Policy for Conducting Assessments for Implementation of Temperature Standards in Discharge Permits*, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-23, effective July 3, 2008.

*Implementing Narrative Standards in Discharge Permits for the Protection of Irrigated Crops*, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-24, effective March 10, 2008.

*Policy for Characterizing Ambient Water Quality for Use in Determining Water Quality Standards Based Effluent Limits*, Colorado Department Public Health and Environment, Water Quality Control Division Policy Number WQP-19, effective May 2002.